VP-25XL

High Precision Compact Linear Stage

Newport®
Experience | Solutions

USER'S MANUAL

For Motion, Think Newport

Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's discretion.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part.

CAUTION

Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - **Load on the stage greater than maximum specified load.**
  - **Carriage speed higher than specified speed.**
  - **Improper grounding.**
    - ¬ **Connectors must be properly secured.**
    - ¬ **When the load on the stage represents an electrical risk, it must be connected to ground.**
  - **Excessive or improper cantilever loads.**
- **Modification of the stage or any part thereof.**

CAUTION

Please return equipment in the original (or equivalent) packing.

You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

No part of this manual may be reproduced or copied without the prior written approval of Newport Corporation.

This manual has been provided for information only and product specifications are subject to change without notice. Any changes will be reflected in future printings.

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EC Declaration of Conformity

VP-25XL

EC Declaration of Conformity

following Annex II-1A
of Directive 2006/42/EC on machinery

Newport
Experience | Solutions

The manufacturer:

MICRO-CONTROLE Spectra-Physics,
1 rue Jules Guesde ZI. Bois de l'Epine - BP189
F-91006 Evry FRANCE

Hereby declares that the machinery:

Description: "VP-25XL"
Function: High Precision Compact Linear Stage
Models: (M-)VP-25XL

– the technical file of which was compiled by:

Mr Dominique DEVIDAL, Quality Director,
MICRO-CONTROLE Spectra-Physics, Zone Industrielle - B.P.29
F-45340 Beaune La Rolande France

– complies with all the relevant provisions of the Directive 2006/42/EC on machinery.
– complies with all the relevant provisions of the Directive 2004/108/EC relating to electro-magnetic compatibility.

– was designed and built in accordance with the following harmonised standards:

NF EN 61326-1:2006 « Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements »
NF EN 55011:2007 Class A

– was designed and built in accordance with the following other standards:

NF EN 61000-4-2
NF EN 61000-4-3
NF EN 61000-4-4
NF EN 61000-4-5
NF EN 61000-4-6

ORIGINAL DECLARATION

Done in Beaune La Rolande on 09 June 2011
Dominique DEVIDAL
Quality Director

DC1-EN rev:A

Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety-related issues occur.

General Warning or Caution

The exclamation symbol may appear in warning and caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

European Union CE Mark

The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

ATTENTION

This stage is a Class A device. In a residential environment, this device can cause radioelectric interferences. In this case, suitable measurements must be taken by the user of this device.

Warnings and Cautions

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.

WARNING

Situation has the potential to cause bodily harm or death.

CAUTION

Situation has the potential to cause damage to property or equipment.

NOTE

Additional information the user or operator should consider.

Warnings

WARNING

The motion of objects of all types carries potential risks for operators. Ensure the protection of operators by prohibiting access to the dangerous area and by informing the personnel of the potential risks involved.

WARNING

Do not use this stage when its motor is emitting smoke or is unusually hot to the touch or is emitting any unusual odor or noise or is in any other abnormal state.

Stop using the stage immediately, switch off the motor power and then disconnect the electronics power supply.

After checking that smoke is no longer being emitted contact your Newport service facility and request repairs. Never attempt to repair the stage yourself as this can be dangerous.

WARNING

Make sure that this stage is not exposed to moisture and that liquid does not get into the stage.

Nevertheless, if any liquid has entered the stage, switch off the motor power and then disconnect the electronics from power supply.

Contact your Newport service facility and request repairs.

WARNING

Do not insert or drop objects into this stage, this may cause an electric shock, or lock the drive.

Do not use this stage if any foreign objects have entered the stage. Switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility for repairs.

WARNING

Do not place this stage in unstable locations such as on a wobbly table or sloping surface, where it may fall or tip over and cause injury.

If this stage has been dropped or the case has been damaged, switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility and request repairs.

WARNING

Do not attempt to modify this stage; this may cause an electric shock or downgrade its performance.

WARNING

Do not exceed the usable depth indicated on the mounting holes (see section “Dimensions”). Longer screws can damage the mechanics or cause a short-circuit.

Cautions

CAUTION

Do not place this stage in a hostile environment such as X-Rays, hard UV,… or in any vacuum environment.

CAUTION

Do not place this stage in a location affected by dust, oil fumes, steam or high humidity. This may cause an electric shock.

CAUTION

Do not leave this stage in places subject to extremely high temperatures or low temperatures. This may cause an electric shock.

- **Operating temperature: +10 to +35 °C.**
- **Storage temperature: -10 to +40 °C (in its original packaging).**

CAUTION

Do not move this stage if its motor power is on.

Make sure that the cable to the electronics is disconnected before moving the stage. Failure to do so may damage the cable and cause an electrical shock.

CAUTION

Be careful that the stage is not bumped when it is being carried. This may cause it to malfunction.

CAUTION

When handling this stage, always unplug the equipment from the power source for safety.

CAUTION

When the carriage is in its end-of-run position, it is strongly recommended not to go beyond this point by using the manual knob as this may damage the stage mechanism.

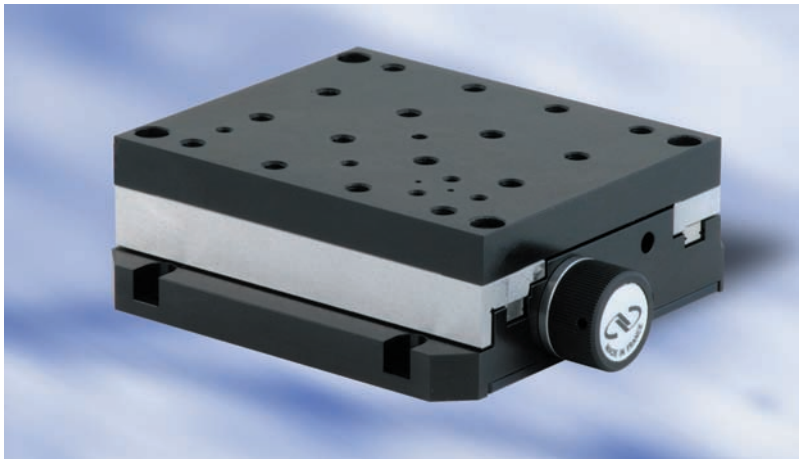
CAUTION

Contact your Newport service facility to request cleaning and specification control every year.

High Precision Compact Linear Stage VP-25XL

1.0 Introduction

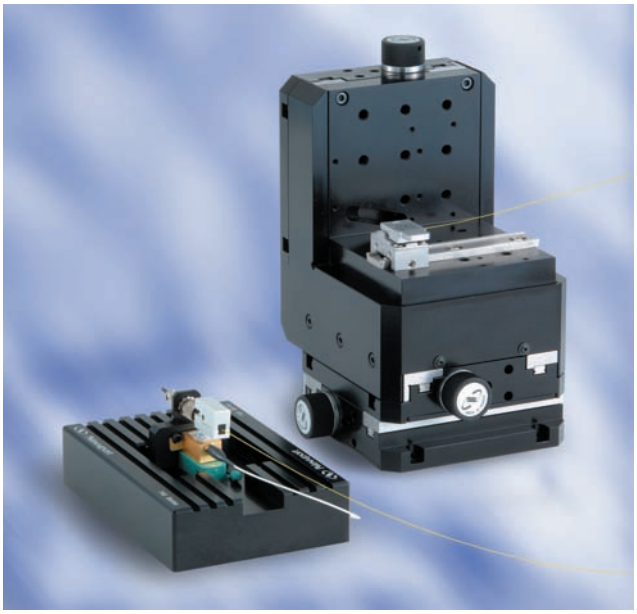
This manual provides operating instructions for the (M-)VP-25XL precision compact linear stage.



(M-)VP-25XL translation stage.

RECOMMENDATION

We recommend you read carefully the chapter "Connection to electronics" before using the (M-)VP-25XL stage.



3 stages (M-)VP-25XL in XYZ configuration.

2.0 Description

The (M-)VP-25XL stages address multi-axis, high precision positioning requirements in fiber optics, biomedical, semiconductor, and high precision test and measurement applications. Features including its ultra-compact size and high reliability make them appropriate for device testing, micro-assembly, micro-machining, and manipulation of small, lightweight parts such as fiber optical devices, micro-optics, MEMS, cell probes, or semiconductor devices.

Based on a high precision drive technology including low-friction ball screw and recirculating ball bearings, the (M-)VP-25XL stages deliver highly reliable positioning performance at a maximum speed of 25 mm/s. Compared to alternative direct-drive technologies, the ball screw drive of the (M-)VP-25XL stages provides greater thrust for higher servo stiffness and load capacity, higher efficiency resulting in less heat induced position drift, as well as minimum tuning efforts. Furthermore, the self-locking at power-off considerably simplifies operational safety.

The modular (M-)VP-25XL stages enable the construction of compact multi-axes positioning systems. For example, by combining three (M-)VP-25XL stages with the VP-BK bracket, a versatile and compact 3 degrees of motion system is produced, keeping the height of the horizontal mounting plate as low as 105 mm (±12.7 mm). For applications requiring up to 6 degrees of motion, our SR50 and PR50 rotation stages and GON series goniometers can be easily added to the system. This complete modular approach provides the greatest advantage regarding flexibility, customization, performance, and ease-of-use.

The (M-)VP-25XL provides a 1 Vpp analog encoder interface. When using with our XPS motion controller, these stages deliver a reliable 10 nm motion sensitivity, and better than 140 nm bidirectional repeatability.

The stage is equipped with two cables of 3 m length with one 25-pin sub-D and one 15-pin sub-D connector for connection to our XPS controller.

2.1 Design Details

Base Material	Aluminum
Bearings	Recirculating ball bearings
Drive Mechanism	Backlash-free ball screw
Drive Screw Pitch (mm)	1
Feedback	Linear steel scale, 20 µm signal period, VP-25XL: 1 Vpp analog sine-cosine output
Limit Switches	Optical
Origin	Optical, at center of travel
Motor	DC servo motor with Tachometer UE25CC
Cable Length (m)	3

3.0 Characteristics

3.1 Definitions

(Absolute) Accuracy

Difference between ideal position and real position.

On-Axis Accuracy

Difference between ideal position and real position after the compensation of linear error sources.

Linear errors include: cosine errors, inaccuracy of screw or linear scale pitch, angular deviation at the measuring point (Abbe error) and thermal expansion effects. All Newport motion electronics can compensate for linear errors.

The relation between absolute accuracy and on-axis accuracy is as follow:

Absolute Accuracy = On-Axis Accuracy + Correction Factor x Travel

Repeatability

Ability of a system to achieve a commanded position over many attempts.

Reversal Value (Hysteresis)

Difference between actual position values obtained for a given target position when approached from opposite directions.

Minimum Incremental Motion (Sensitivity)

The smallest increment of motion a device is capable of delivering consistently and reliably.

Resolution

The smallest increment that a motion device can be commanded to move and/or detect.

Eccentricity

Displacement of the geometric center of a rotation stage from the rotation axis in the plane defined by bearings.

Wobble

Tilt of rotation axis during rotation of a stage.

The testing of on-axis accuracy, repeatability, and reversal error are made systematically with our test equipment in an air-conditioned room (20 °C ±1 °C).

Each rotation stage is tested with a precision optical encoder.

A linear cycle with 21 measures on the travel and 4 cycles in each direction gives a total of 164 points.

3.2 Mechanical Specifications

Travel Range (mm)	25
Resolution (µm)	0.0006 (1)
Sensitivity (µm)	0.01 (1)
Bidirectional Repeatability (µm)	0.14 guaranteed (1)
On-Axis Accuracy (µm)	1.0 typical, 2.0 guaranteed
Maximum Speed (mm/s)	25
Pitch, Yaw (µrad)	50 typical, 100 guaranteed
MTBF (h)	20,000 (2)

1) When used with XPS motion controller.
2) See chapter: "Maintenance".

The MTBF value indicated above is given to use the stage with the following parameters:

Centered load	(N)	50
Displacements	(mm)	2
Speed	(mm/s)	10
Operating rate on the cycle		50%
Cycle	21 hours/day 330 days/year	

3.3 Load Specification Definitions

Normal Load Capacity (Cz)

Maximum load a stage can move while maintaining specifications.

This value is given with speed and acceleration specified for each stage, and with a load perpendicular to bearings.

Specified Speed	(mm/s)	25
Specified Acceleration	(mm/s^2)	100

Axial Load Capacity (±Cx)

Maximum load along the direction of the drive train.

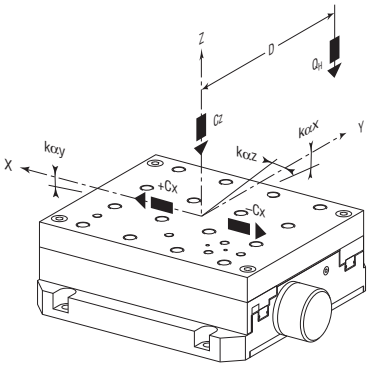
Off-Centered Load (Q)

Maximum cantilever-load a stage can move: $Q \leq Cz / (1 + D/30)$

D: Cantilever distance.

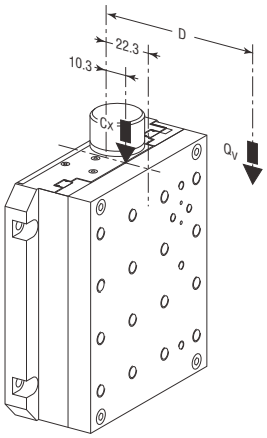
3.4 Load Characteristics and Stiffness

Cz	60 N
-Cx; +Cx	40 N
kαx	20 µrad/N.m
kαy	20 µrad/N.m
kαz	30 µrad/N.m



Normal Load Characteristics

Q_H	Off-center load, $Q_H \leq Cz/(1 + D/30)$
D	Cantilever distance in mm
Cz	Normal center load capacity on bearings
+Cx	Direct load capacity on X axis
-Cx	Inverse load capacity on X axis
kαx	Angular stiffness (Roll)
kαy	Angular stiffness (Pitch)
kαz	Angular stiffness (Yaw)



Axial Load Characteristics

Q_V	Off-center load, $Q_V \leq Cz/(1 + D/30)$
D	Cantilever distance in mm between the center of mass of the load and the bearings center.
22.3	Distance between top surface and the bearings center in mm.
10.3	Distance between under the top plate and the bearings center in mm.

3.5 Stage Weights

Weight indicated is the value for the stage with the top plate and cables.

(M-)VP-25XL	[lb (kg)]	3.3 (1.5)

4.0 Drive

The (M-)VP-25XL stage is equipped with DC-motor and a metal optical scale.

Specifications

	Resolution (nm)	Maximum Speed (mm/s)	Motor
(M-)VP-25XL	0.6 (1)	25	UE25CC

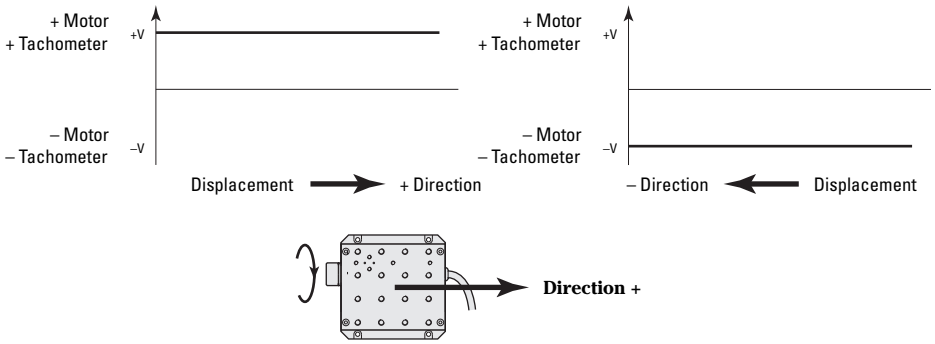
1) *XPS internal resolution used for position calculation, approx. 5 nm noise on position.*

5.0 Motor

5.1 DC Motor Characteristics

Motor	Nominal Voltage (V)	Max. Current (A)	Resistance (Ω)	Inductance (mH)
UE25CC	48	0.9	8	0.83

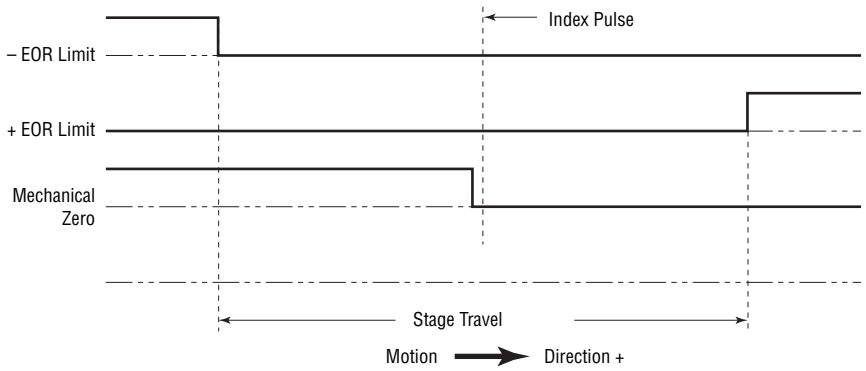
5.2 Command Signals for UE25CC DC Motor



In the above drawings, + Motor signal is referred to – Motor signal, + Tacho Generator signal is referred to – Tacho Generator signal.

1. When the stage moves in + Direction, the + Motor voltage is higher than – Motor voltage, and + Tacho Generator voltage is higher than – Tacho Generator voltage.
2. When the stage moves in – Direction, the + Motor voltage is lower than – Motor voltage, and + Tacho Generator voltage is lower than – Tacho Generator voltage.

5.3 Sensor Position

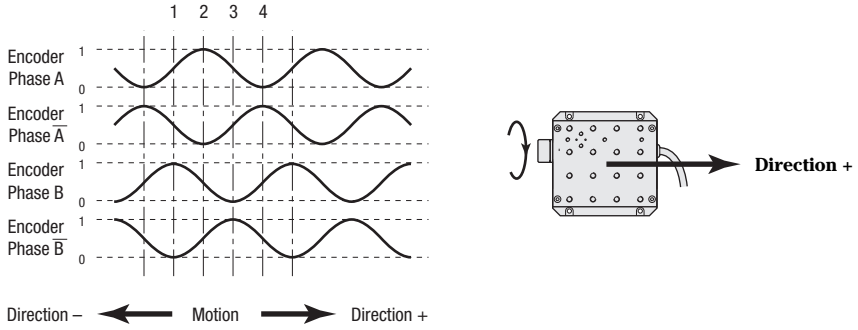


End-of-Run and Mechanical Zero are TTL type: 5 V ±5%, 2 mA max.

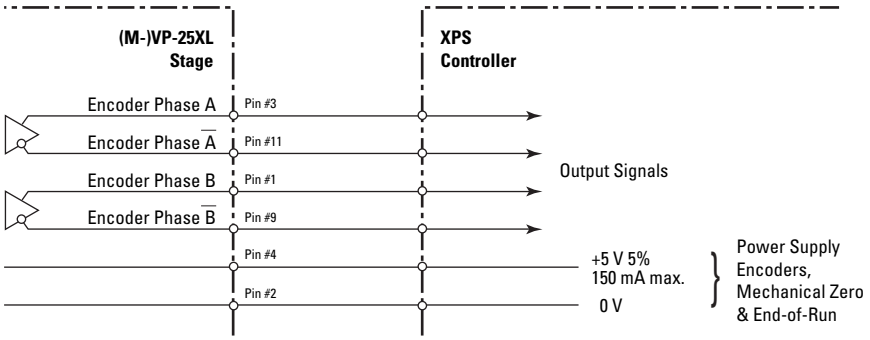
CAUTION

"End-of-Run" and "Mechanical Zero" are active signals and should not be connected to any other source. Use appropriate TTL type receivers.

5.4 Feedback Signal Position



The incremental shaft encoder consists of a optical scale and an encoder head. When the sensor shaft turns, the encoder head generates sine-cosine signals in quadrature, sent to pins #1, #3, #9 and #11 of the 15-pin Sub-D connector.



Encoders are “differential pair” type output signals. Using these signals permits a high immunity to noise.

5.5 Pinouts

15-pin Sub-D and 25-pin Sub-D connections for (M-)VP-25XL stages are given in the following table:

UE25CC		M-VP-25XL	
1	Encoder Phase B	**1**	+ Tachometer
2	0 V Encoder	**2**	N.C.
3	Encoder Phase A	**3**	– Tachometer
4	Encoder Power: +5 V	**4**	N.C.
5	N.C.	**5**	+ Motor
6	N.C.	**6**	+ Motor
7	Index Pulse /I	**7**	– Motor
8	N.C.	**8**	– Motor
9	Encoder Phase /B	**9**	N.C.
10	N.C.	**10**	N.C.
11	Encoder Phase /A	**11**	N.C.
12	N.C.	**12**	N.C.
13	N.C.	**13**	Mechanical Zero
14	Index Pulse I	**14**	Shield Ground
15	N.C.	**15**	N.C.
		16	0 V logic
		17	+ End-of-Run
		18	– End-of-Run
		19	N.C.
		20	N.C.
		21	N.C.
		22	N.C.
		23	N.C.
		24	N.C.
		25	N.C.

6.0 Connection to Newport Controllers

6.1 Warnings on Controllers

Controllers are intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Read the controller user's manual carefully before operating the instrument and pay attention to all written warnings and cautions.

WARNING

Disconnect the power plug under the following circumstances:

- **If the power cord or any attached cables are frayed or damaged in any way.**
- **If the power plug is damaged in any way.**
- **If the unit is exposed to rain, excessive moisture, or liquids are spilled on the unit.**
- **If the unit has been dropped or the case is damaged.**
- **If you suspect service or repair is required.**
- **Whenever you clean the electronics unit.**

CAUTION

To protect the unit from damage, be sure to:

- **Keep all air vents free of dirt and dust.**
- **Keep all liquids away from the unit.**
- **Do not expose the unit to excessive moisture (85% humidity).**
- **Read this manual before using the unit for the first time.**

WARNING

All attachment plug receptacles in the vicinity of this unit are to be of the grounding type and properly polarized.

Contact your electrician to check your receptacles.

WARNING

This product is equipped with a 3-wire grounding type plug.

Any interruption of the grounding connection can create an electric shock hazard.

If you are unable to insert the plug into your wall plug receptacle, contact your electrician to perform the necessary alterations to ensure that the green (green-yellow) wire is attached to earth ground.

WARNING

This product operates with voltages that can be lethal.

Pushing objects of any kind into cabinet slots or holes, or spilling any liquid on the product, may touch hazardous voltage points or short out parts.

6.2 Connection

On the stage is a label which indicates its name, its serial number and the motor it is equipped with (eg.: UE25CC).

VP-25XL	S/N #
Encoder: 5V	Motor: UE25CC
D.C Motor	U=48VDC I=1A

WARNING

Always turn power OFF on electronics units before connecting them to stage.

WARNING

The (M-)VP-25XL stage 25-pin Sub-D connector must be connected to an XPS-DRVM5 driver board.

The 25-pin Sub-D cable must be plugged to one of these connectors

The 15-pin Sub-D cable must be plugged to the corresponding number encoder connector

The (M-)VP-25XL stage 15-pin Sub-D connector must be connected to the XPS rear panel "Encoder" connector corresponding to number of the axis on which the above mentioned XPS-DRVM5 is connected to.

6.3 Cables

Our (M-)VP-25XL stage is delivered equipped with two 3-meter cables, one with a 15-pin Sub-D connector and the other one with a 25-pin Sub-D connector. It can be directly connected to our XPS controller.

WARNING

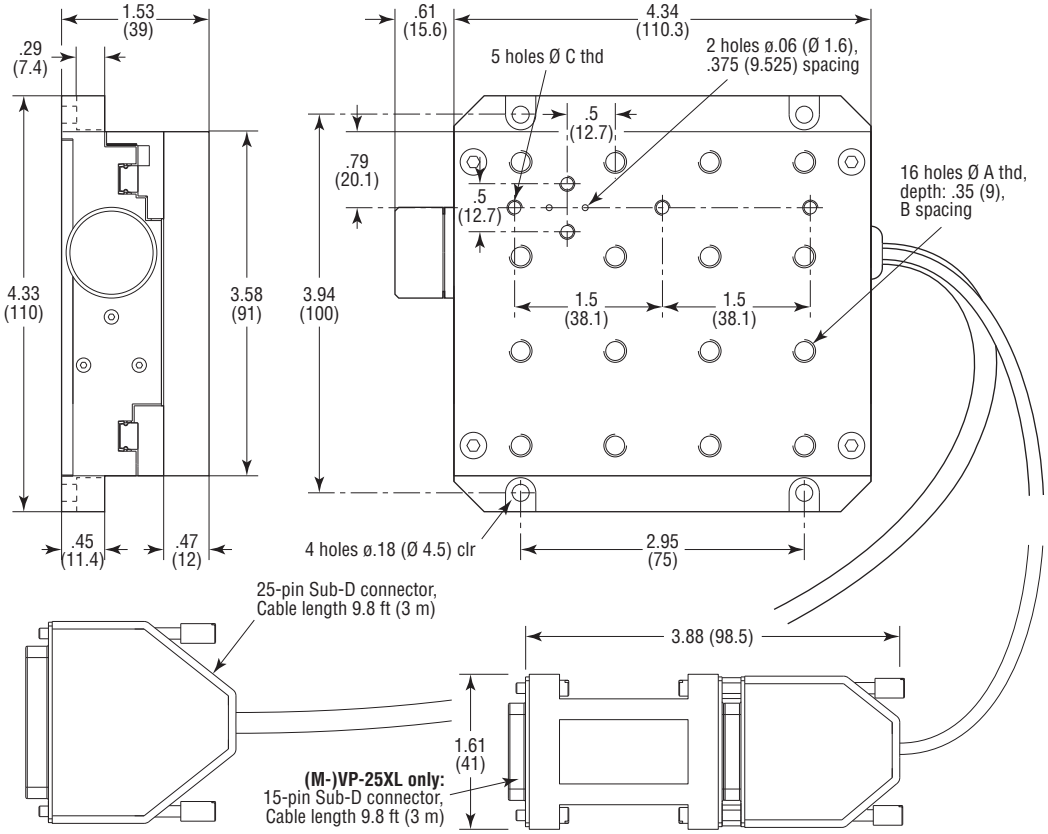
These cables are shielded correctly. For a correct operation, make sure to lock connectors (ground continuity provided by cables).

WARNING

Keep the cables at a safe distance from other electrical cables in your environment to avoid potential cross talk.

7.0 Dimensions

7.1 (M-)VP-25XL Precision Compact Linear Stage

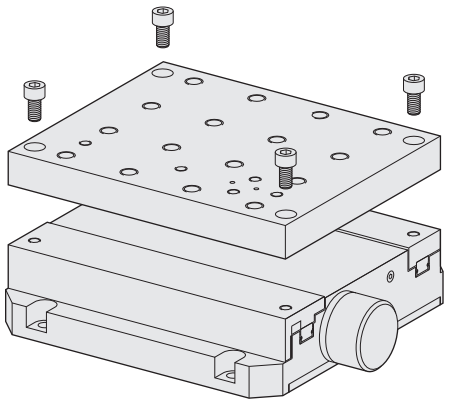


CAUTION

To reach the specifications stated for (M-)VP-25XL, stages must be fixed on a plane surface with a flatness of 5 µm.

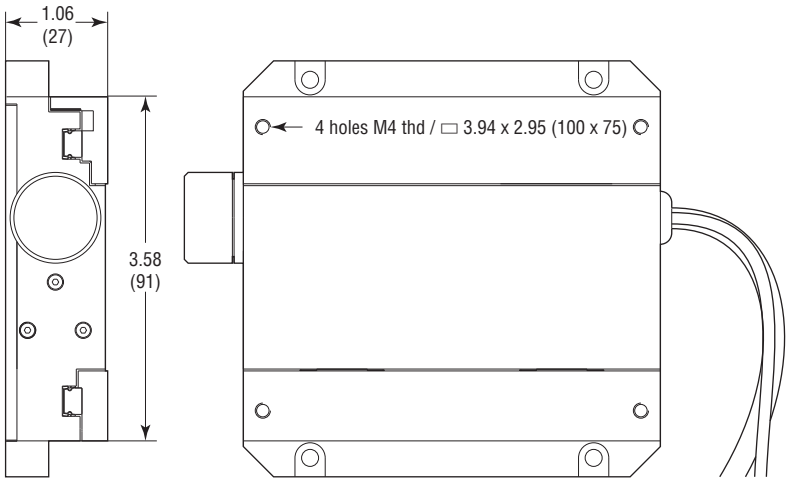
7.2 (M-)VP-25XL Stage without Top Plate Interface

Sometimes, it is necessary to remove the top plate interface of a (M-)VP-25XL stage (to make an XY assembly, for example).



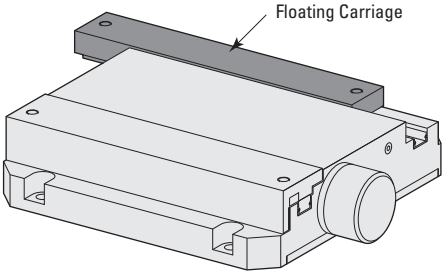
To do so, just unscrew the 4 CHc M4 x 12 / □ 100 x 75 screws of the top plate with the wrench supplied with the stage.

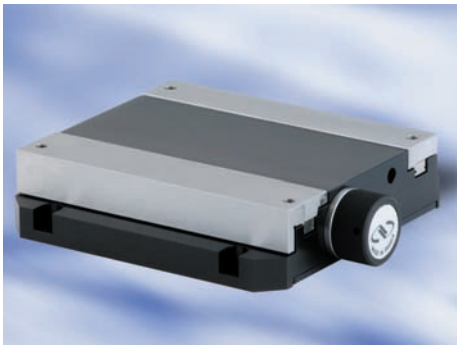
(M-)VP-25XL stage will then have the following interface:



CAUTION

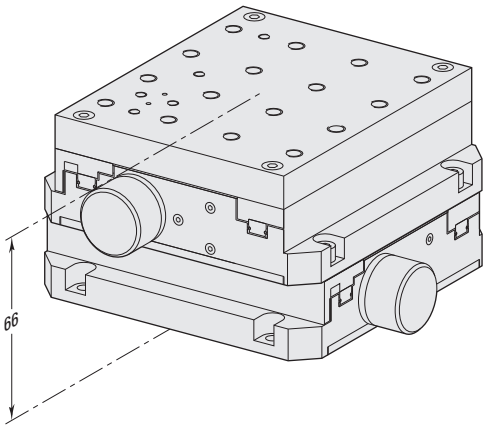
Once the top plate interface removed, one of carriages is floating on its axis.





8.0 Assemblies

8.1 XY Mounting

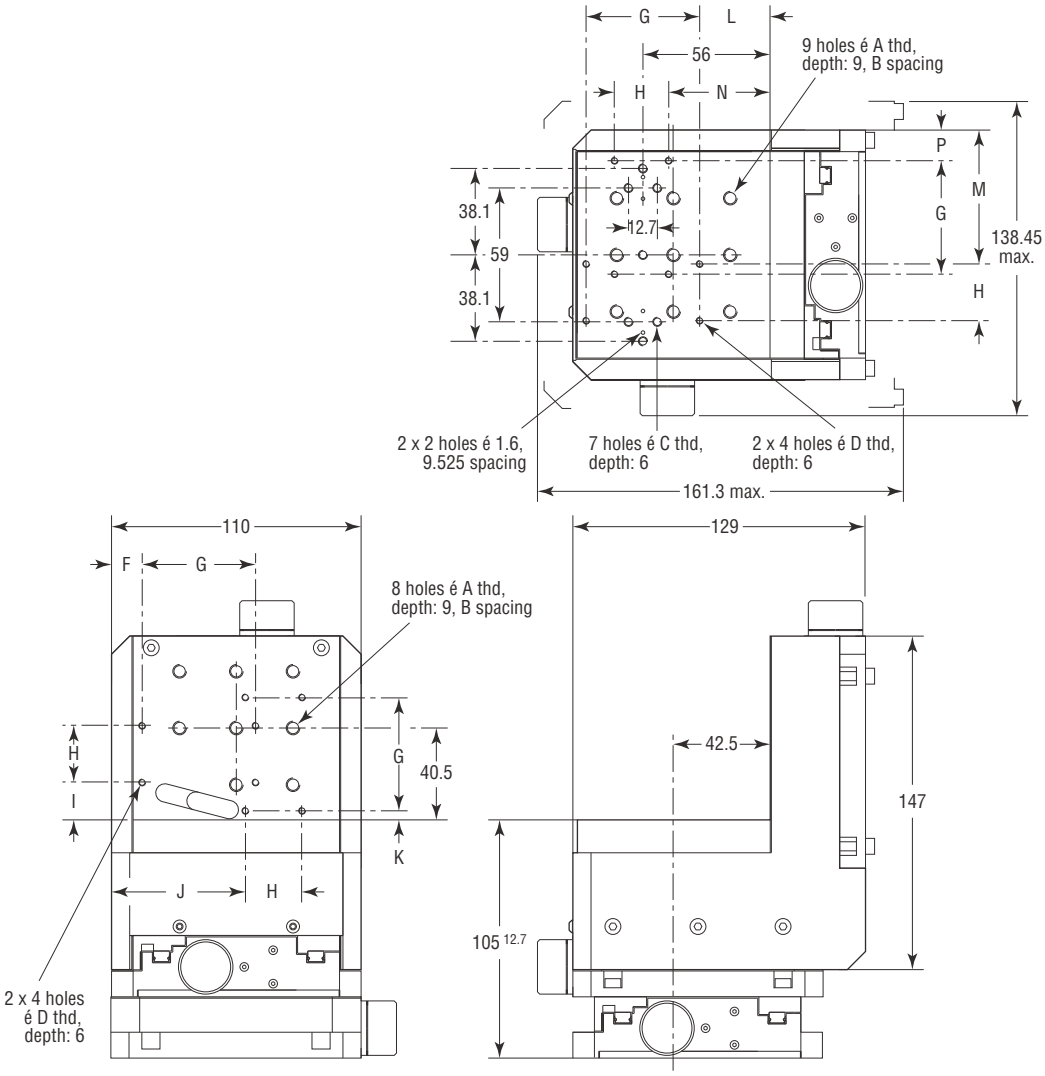


CAUTION

- **To make an XY stage assembly, it is necessary to tighten screws firstly on the driving carriage of the lower stage, then the ones on the floating carriage.**
- **The lower stage must be fixed on a plane surface with a flatness of 5 µm.**

8.2 XYZ Configuration

(M-)VP-25XL stages can easily be assembled into XYZ configuration with optional (M-)VP-BK bracket.



CAUTION

- **To fix stages together or with the bracket for an XYZ assembly, it is necessary to tighten screws firstly on the driving carriage, then the ones on the floating carriage.**
- **The lower stage must be fixed on a plane surface with a flatness of 5 µm.**

9.0 Maintenance

RECOMMENDATION

It is recommended to contact our After Sales Service which will know to define the appropriate maintenance for your application.

9.1 Maintenance

The (M-)VP-25XL stage requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and manipulated with precaution.

PRECAUTIONS

The (M-)VP-25XL stage must operate, and be stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return your stage to our After Sales Service after every 2000 hours of use for lubrication.

If your (M-)VP-25XL stage is mounted on a workstation and cannot be easily dismantled, please contact our After Sales Service for further instructions.

9.2 Repairing

CAUTION

Never attempt to disassemble an element of the stage that has not been specified in this manual.

To disassemble a non specified element can cause a malfunction of the stage.

If you observe a malfunction in your stage, please immediately contact us to make arrangements for a repair.

CAUTION

All disassembly attempts or repair of stage without authorization will void your warranty.

9.3 Calibration

CAUTION

It is recommended to return your stage to Newport once a year for a recalibration to its original specifications.

Service Form

Your Local Representative
Tel.: _____
Fax: _____

Name: _____ Return authorization #: _____
(Please obtain prior to return of item)

Company: _____

Address: _____ Date: _____

Country: _____ Phone Number: _____

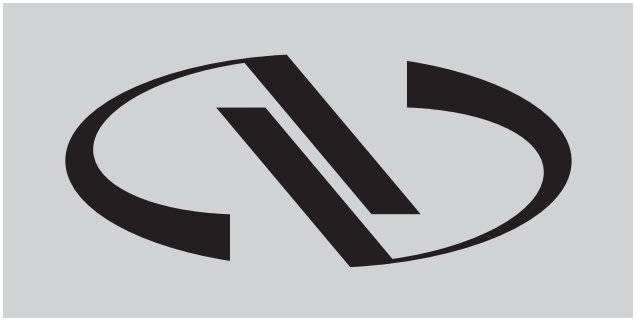
P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

Reasons of return of goods (please list any specific problems): _____



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